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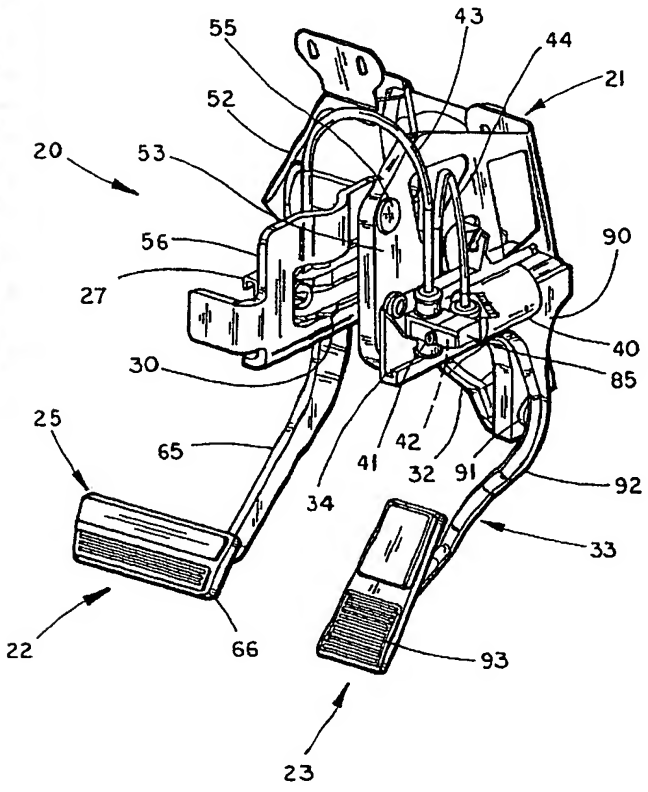
(54) Title: ADJUSTABLE PEDAL APPARATUS FOR VEHICLES



(57) Abstract: A pedal-supporting apparatus (20) includes a support (21) configured for attachment to a vehicle firewall, and a brake pedal subassembly (22) and an accelerator pedal subassembly (23) pivoted to the support (21). The brake pedal subassembly (22) includes an upper portion pivotally engaging the support, and a brake pedal coupled to the upper portion (32) by a linear adjustment device comprising a vertically-elongated C-shaped track and follower. A rack on the track is engaged by a worm gear (30) for adjusting the brake pedal location. The accelerator pedal subassembly (22) is similarly supported. A reversible motor includes a driving gear, and gear-driven cables engage the driving gear and extend from the driving gear in series to worm gears (30) on each adjustment device so that the brake pedal and accelerator pedal are simultaneously and equally adjusted upon actuation of the motor. A stop lever is incorporated into the pedal as desired.

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ADJUSTABLE PEDAL APPARATUS FOR VEHICLES

BACKGROUND OF INVENTION

The present invention relates to under-dash pedal systems for vehicle control, and more particularly relates to adjustable foot pedals that are adjustable relative to a seated person in a vehicle for optimal positioning and function.

Adjustable foot pedal systems for control of vehicles are known. For example, see U.S. Patent 3,828,625. However, improvements are desired to allow linear adjustment of the pedals so that a location of the pedals to the vehicle floor and to the driver can be more appropriately controlled. For example, it is desirable to adjust the pedals in a manner that is most similar to adjusting a vehicle seat, since linearly adjusting a vehicle seat relative to foot pedals is widely accepted by the public and government regulators. However, a problem may result if the pedals are linearly adjusted because, with conventional thinking, this requires that the actuators (e.g. push rods, cables, and mechanical linkages) connecting the pedals to the associated vehicle components (e.g. a master brake cylinder, an engine throttle, or a clutch) be lengthened or shortened as the pedals are adjusted. Some designers are hesitant to make a length of actuators adjustable because this can introduce play, wear, and reduced reliability into the actuator. Nonetheless, there are potential cost savings if foot pedals are made adjustable instead of a vehicle seat being adjustable on a floor pan of the vehicle.

Even if the above challenges are overcome, the adjustable pedal system must be able to meet certain functional criteria. For example, the braking pedal must be able to withstand significant torsional stress that occurs during hard braking of the vehicle. Further, the accelerator and brake pedal systems should preferably position the accelerator pedal and the brake pedal at the same relative positions after an adjustment, so that the driver does not mis-hit or have other problems when quickly switching from one pedal to the other. At the same time, the accelerator and brake pedal systems must be relatively simple, reliable, and very durable for long use. Another problem is caused by horizontally/rearwardly extending and protruding objects. It is undesirable to incorporate such protruding objects under an instrument panel or dash where they can cause leg and knee injury during a vehicle crash. Also, there is not much room under an instrument panel, such that any pedal system must take up a minimum of space.

Accordingly, an apparatus solving the aforementioned problems and having the aforementioned advantages is desired.

SUMMARY OF THE INVENTION

In one aspect of the present invention, an adjustable pedal apparatus includes a support configured for attachment to a vehicle and a pedal supporting-subassembly. The pedal-supporting subassembly includes an upper portion pivotally engaging the support and a lower portion supporting a pedal construction. The pedal-supporting subassembly also includes an adjustment mechanism connecting the upper and lower portions. The adjustment mechanism includes a longitudinally elongated track having a transverse cross section with an elongated vertical dimension defined by upper and lower flanges that stiffen the track, and includes a follower slidably engaging the track. By this arrangement, forces on the pedal construction are resisted in an improved manner by the track and follower.

In another aspect of the present invention, an adjustable pedal apparatus includes a first support structure adapted for fixed attachment to a vehicle and a pedal-supporting subassembly supported by the first support structure. The pedal-supporting subassembly includes an upper portion, a lower portion supporting a pedal construction and an adjustment mechanism adjustably connecting the upper and lower portions. The pedal-supporting subassembly also includes a pivot on one of the first support structure, the upper portion, the lower portion, and the adjustment mechanism for pivoting the pedal construction along a predetermined path of movement relative to the first support structure when the pedal construction is depressed. The pedal construction includes a connector adapted for attachment to an actuator for a vehicle system, such as a push rod actuator for a master cylinder of a vehicle braking system. The adjustment mechanism includes a longitudinally elongated track and further includes a mating follower slidably engaging the track. The adjustment mechanism still further includes a drive mechanism for selectively motivating the follower along the track. The track has a vertically elongated cross section, and the follower has a mating cross section with longitudinally extended interfacing surfaces constructed to provide a constant coefficient of friction that generates resistance when the pedal construction is depressed, the bearing material reducing excessive wear and also reducing transmission of forces directly from the pedal construction through the adjustment mechanism to the drive mechanism when the pedal construction is depressed.

In another aspect of the present invention, an adjustable pedal apparatus includes a support configured for attachment to a vehicle. The adjustable pedal apparatus also

includes a pedal-supporting subassembly with an upper portion pivotally engaging the support, a lower portion supporting a pedal construction, and an adjustment mechanism connecting the upper and lower portions. The adjustment mechanism includes a longitudinally elongated track attached to the upper portion, and includes a follower slidably engaging the track that is attached to the lower portion. The follower includes a rack of teeth extending at least partially along its length. A drive mechanism includes a housing attached to the track and further includes a drive gear operably mounted in the housing and engaging the rack of teeth for driving the follower along the track when the gear is rotated. The drive mechanism further includes an electromechanical device for motivating the drive gear to move the follower.

In yet another aspect of the present invention, an adjustable pedal apparatus includes a support configured for attachment to a vehicle. The adjustable pedal apparatus also includes a pedal-supporting subassembly with an upper portion pivotally engaging the support, a lower portion supporting a pedal construction, and an adjustment mechanism connecting the upper and lower portions. The adjustment mechanism includes a track and a follower slidably engaging the track. An actuator is coupled to the upper portion and adapted for operative connection to a control system of a vehicle for operating the control system when the upper portion is moved. An adjuster for adjusting the adjustment mechanism is provided. A stop is also provided on the pedal supporting subassembly, the stop being adapted to engage a stop surface on the vehicle when the pedal construction is depressed a predetermined maximum amount.

In still another aspect of the present invention, a method of adjusting pedals in a vehicle comprises steps of providing a support structure and a pedal-supporting subassembly, where the pedal-supporting subassembly includes an upper portion pivoted

These and other features, advantages, and objects of the present invention will be further understood and appreciated by those skilled in the art by reference to the following specification, claims, and appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a front top perspective of an adjustable pedal apparatus embodying the present invention;

Fig. 2 is an exploded perspective view of the brake pedal subassembly shown in Fig. 1;

Fig. 3 is a front perspective of the brake pedal subassembly and the accelerator pedal subassembly shown in Fig. 1;

Fig. 4 is a rear perspective view of the apparatus shown in Fig. 3, the mounting bracket of the accelerator pedal subassembly being removed to more clearly show the underlying components;

Fig. 5 is an exploded perspective view of the accelerator pedal subassembly shown in Fig. 4;

Figs. 6-9 are right side, front, left side, and top views of the apparatus shown in Fig. 1; and

Fig. 10 is an exploded perspective view of the apparatus shown in Fig. 2, but including the support adapted to engage a vehicle firewall.

Figs. 11 and 12 are side and front views of an adjustable pedal system including a down stop arm; and

Figs. 13 and 14 are perspective views of accelerator and brake pedals similar to Figs. 5 and 2, respectively, including a down stop arm.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

A pedal-supporting apparatus 20 (Fig. 1) includes a support 21 configured for attachment to a vehicle firewall under the vehicle's instrument panel, and a brake pedal subassembly 22 and an accelerator pedal subassembly 23 separately pivoted to the support 21. The brake pedal subassembly 22 (Fig. 2) includes a brake-pedal-supporting upper portion 24 pivotally engaging the support 21, and a brake pedal lower portion 25 coupled to the brake-pedal-supporting upper portion 24 by a linear adjustment device 26 comprising a C-shaped linear track or channel 27 and a follower 28 with blade-shaped edges for operably engaging the track 27. A rack 29 (Fig. 10) on the track 27 is engaged by a worm gear 30 for adjusting the location of the brake pedal lower portion

25. The accelerator pedal subassembly 23 (Fig. 1) includes an accelerator-pedal-supporting upper portion 32 pivotally engaging the support 21, and an accelerator pedal lower portion 33 (Fig. 5) coupled to the accelerator-pedal-supporting member 32 by a second linear adjustment device 34 comprising a C-shaped track or channel 35 and a follower 36 with blade-shaped edges operably slidably engaging the channel 35. A second rack 37 on the track 35 is engaged by a second worm gear 38 for adjusting the location of the accelerator pedal 33. (The rack 37 and gear 38 are similar to rack 29 and gear 30 in Fig. 10.) A reversible electric DC motor 40 includes a rotatable shaft 41 and a driving gear 42 on an end of the shaft 41. The driving gear 42 is operably engaged by driven gears on the end of cables 43 and 44. The cables 43 and 44 extend from the driven gears to the worm gears 30 and 38, respectively, so that the brake pedal lower portion 25 and accelerator pedal lower portion 33 are simultaneously and equally adjusted upon actuation of the motor 40. This provides a reliable and yet relatively non-complex assembly that can withstand the wear and abuse associated with high use in service, and that can withstand the occasional high stress during use, yet that can provide the structural and cost benefits of such a device.

The support 21 (Fig. 10) includes a wall section 50 with flanges configured for secure connection to a vehicle firewall 51 (Fig. 6). A pair of wall sections 52 and 53 (Fig. 10) extend forwardly from wall section 50 and include reinforcement ribs and flanges as needed for stiffening. Holes 54 are provided for receiving a pivot pin 55 for pivoting the brake pedal subassembly 22, and holes 91' are provided for pivoting the accelerator pedal subassembly.

As noted above, the brake pedal subassembly 22 (Fig. 10) includes an upper portion 24 and a lower portion 25 slidably secured to the upper portion 24. The upper portion 24 includes a U-shaped bracket 56 having a rear flange 57 and side flanges 58 and 59. The side flanges 58 and 59 fit mateably between the wall sections 52 and 53, and include holes 60 for receiving pivot pin 55 to pivotally mount the brake pedal subassembly 22 to the support 21. A connector 61 (Fig. 2) pivotally connects a push rod 62 to the mounting bracket 56. The push rod 62 is configured to be coupled to a master brake cylinder of a vehicle braking system in a manner known in the art, such that a detailed description of that aspect is not necessary for an understanding of the present invention. Notably, linear adjustment of the lower portion 25 of the brake pedal

subassembly 22 on the upper portion 24 does not affect the position or operation of the push rod 62, which is a significant advantage in this adjustable system.

The lower portion 25 of the brake pedal subassembly 22 (Fig. 10) includes a structural arm 65 and a foot pedal pad 66 attached to a lower end of the arm 65. An upper end of the structural arm 65 is T-shaped, and includes an elongated top bracket 67.

The lower portion 25 is linearly slidably and adjustably connected to the upper portion 24 with a linear adjustment mechanism 26 (sometimes called an "adjustment device") that includes the hat-shaped channel 28 (sometimes called a "follower" herein) secured to the top bracket 67, and the C-shaped channel 27 (sometimes called a "guide" or "track") secured to the side flange 59 of the bracket 56. The C-shaped channel 27 is vertically elongated for beam strength (which is required to withstand a vehicle driver pressing hard on the foot pedal pad 66), and includes top and bottom flanges 73 and 74 that stiffen the channel 27 and that form a concave region defining a track. The hat-shaped channel 28 includes opposing edges 75 and 76 defining a blade shaped feature that mateably slidably engages the concave region (i.e. the track) defined by the C-shaped channel 27. Lubricious bearing material 77 is attached to the edges 75 and 76 if needed for added long-term durability and for a constant coefficient of friction, if needed. Notably, some friction (i.e. a heightened level of static friction) may be desirable to stabilize the linear adjustment mechanism in an adjusted position.

The rack 29 has a plurality of teeth and is attached to the hat-shaped channel 28 in a location where the teeth extend parallel the track of channel 27. At the end of the teeth on the rack 29 is a section of material 79 creating a stop for engaging the worm gear 30 in an abutting manner preventing binding. The worm gear 30 is operably attached to the C-shaped channel 27 by a bearing that holds the worm gear 30 in operative contact with the rack 29. A cable assembly (Fig. 2) includes a sleeve 80 attached to the hat-shaped channel 28 and the inner telescoping/rotatable cable 43 attached to the worm gear 30 for driving the worm gear 30. The ratio of a rotation of the worm gear 30 to movement along the rack 29 can be varied by design for specific applications, but it is contemplated that a ratio will be chosen that prevents back driving of the worm gear 30 and that prevents backlash of the linear adjustment mechanism, but that allow quick adjustment. For example, it is contemplated that a ratio of about 5 to 1 will work satisfactorily.

The motor 40 (Fig. 5) is a reversible electric DC motor operable on a voltage and amperage as are presently used in modern vehicles, such as in a 12 volt circuit. For example, it is contemplated that a motor similar to that used in power-adjusted seat mechanisms will be used, although different motors and motivating devices are known that could be made to work. For reference, the illustrated motor used in early testing has a free rotational speed of about 650-rpm, and a loaded speed of about 400-rpm. The motor 40 is located in a convenient location where kinking and tight bending of the cables 43 and 44 are not a problem. The illustrated motor 40 (Fig. 1) is mounted to a side of the wall section 53 at a location where it is relatively close to the racks 29 and 37 and where cables 43 and 44 can be extended to the racks 29 and 37 without kinking in all of the adjusted positions of the subassemblies 22 and 23. The motor 40 includes a rotatable shaft 41 and a driving gear 42 on an end of the shaft 41. A gear housing 84 (Fig. 1) is mounted to an end of the motor 40 and includes a pair of cavities for the driven gears engaging the driving gear 42. The driven gears are attached to one end of the cables 43 and 44, such that when the shaft 41 of motor 40 is rotated, the cables 43 and 44 are simultaneously rotated. The other ends of the cables 43 and 44 are connected to worm gears 30 and 38 so that, as the cables 43 and 44 are rotated, the subassemblies 22 and 23 are simultaneously linearly adjusted an equal amount. The equal and simultaneous adjustment is believed to be very important so that the pedals 25 and 33 remain in similar relative locations, so that a vehicle driver does not "mis-hit" one of the pedals 25 or 33 when moving his/her foot from one pedal to the other. (i.e. Simultaneous and equal adjustment tends to reduce any potential for problems and driver confusion during "cross over" operation of the pedals.)

To adjust the brake pedal subassembly, the motor 40 is actuated, and the worm gear 30 rotated until a desired adjusted position is achieved. To use the brake pedal, the vehicle driver presses on the foot pedal pad 66, and the entire brake pedal subassembly 22 (including the upper and lower portions 24 and 25) rotate as a unit, thus pushing the push rod to operate the master brake cylinder of the vehicle brake system.

The accelerator pedal subassembly 23 (Fig. 5) includes an accelerator pedal upper portion 32 and an accelerator pedal lower portion 33 slidably secured to the upper portion 32, in a manner that is similar to that of the brake pedal subassembly 22. Specifically, the upper portion 32 includes a top bracket 90 pivoted to the support 21 by a pivot pin 91 and a connector 89 for connection to a throttle control actuator push rod

90' of the vehicle engine. The lower portion 33 includes a structural arm 92, an accelerator foot pedal pad 93 on a lower end of the arm 92, and an upper bracket 94. The linear adjustment mechanism 34 includes a C-shaped channel 35 (sometimes called a "guide" herein) defining a track and a follower 36 having edges defining a blade-shape for linearly slidably engaging the channel 36. The rack 37 is attached to the channel 35, and the worm gear 38 is attached to the follower 36 in operative engagement with the rack 37. The cable 44 is secured to the worm gear 38, and extends to a driven gear of the transmission on the motor 40. The arrangement of the accelerator pedal subassembly 23 is not unlike brake pedal subassembly 22. A device can be attached to pivot pin 91 to help hold the accelerator pedal subassembly 23 in a selected pivoted position to reduce stress on a driver's foot when operating the vehicle. The device 98 provides a hysteresis effect that helps hold a selected position, but allows the accelerator pedal subassembly 23 to return to a "gas-off" position when released by the driver.

Notably, the linear adjustment devices 26 and 34 are positioned high relative to the associated respective pivot pins 55 and 91. In this "high" location, the linear adjustment devices 26 and 34 are tucked up under the instrument panel of the vehicle where they are partially shielded. This improves appearance and safety. The long vertical dimensions of the pedal arms 65 and 92 create substantial torque on the linear adjustment devices 26 and 34 (especially on brake arm 26 during hard braking), but the elongated vertical dimension of the linear adjustment deices 26 and 34 provide the torsional resistance to prevent failure and excessive wear. Also, the relatively short horizontal/lateral dimension of the devices 26 and 34 maintain a small envelope, such that a minimum of space is required under the instrument panel to contain them.

A pedal-supporting apparatus 200 (Figs. 11-12) includes an overtravel stop arm 203 designed to resist hard pressure on a pedal during the overtravel portion of a pedal's movement. It is noted that the present stop arm 203 will work on linearly adjustable pedal apparatus, like apparatus 20, but also it will work on non-linearly adjustable pedal systems, as well.

The pedal-supporting apparatus 200 (Figs. 11-12) includes a pedal-supporting member 201 shaped to pivotally engage a firewall-attached support on a vehicle, and further includes a clutch pedal 202 adjustably attached to the pedal-supporting member 201. A non-adjustable overtravel stop arm 203 (sometimes called a "down stop" herein) is secured to the pedal-supporting member 201. The non-adjustable stop arm 203

includes a stop surface 204 located on the stop arm 203 such that the stop surface 204 engages a stop area 205 on the firewall 206 of the vehicle to prevent overtravel of the pedal 202, even when the clutch pedal 202 is adjusted to a rearward-most position for a "short-legged" person.

The illustrated pedal-supporting member 201 includes a track 208 and the clutch pedal 202 includes a follower 209 shaped to linearly engage the track 208, similar to the track 27 and follower 28 disclosed in Fig. 2. A top bracket 210 is attached to the track 207, and the stop arm 203 extends downwardly and rearwardly from the top bracket 210. The top bracket 210 includes a top fixed pivot 211, and further includes a push-rod connector 212 for connection to a clutch release push rod 213. The pedal 202 includes the follower 209, which is hat-shaped and linearly engages the track 208. When the pedal 202 is depressed, the pedal-supporting member 201 and the pedal 202 pivotally move as a unit until the stop arm 203 engages the stop area 205 to prevent overtravel of the pedal 202. When the pedal 202 is adjusted by causing the actuator (not specifically shown, but see Figs. 1-10) to move the follower 209 along the track 208, the pedal 202 is moved toward or away from the vehicle firewall 206 (and toward or away from a vehicle driver). However, the distance of the stop arm 203 does not change relative to the stop area 205. Therefore, the stop arm 203 functions to limit overtravel of the pedal 202 regardless of how the pedal apparatus is adjusted.

It is noted that an up stop, such as is illustrated by up stop member 216, can be attached to the bracket 210. The up stop member 216 is located so that it engages a mating part of the vehicle, to limit forward travel of the pedal 202 when the pedal 202 is released. The illustrated up stop member 216 comprises a tab extending from a side of the bracket 210, and includes side reinforcement flanges.

The apparatus 123 (Fig. 13) and apparatus 122 (Fig. 14) are similar to the apparatus 23 (Fig. 5) and apparatus 22 (Fig. 2), respectively. Similar and identical components are identified with the same identification number, except that a value of "100" is added to the identification number. In Figs. 13 and 14, the overtravel stop arm is identified with the number 303, since its operation and shape is similar to the stop arm 203 in Figs. 11-12. The stop arms 303 are fixed to the top brackets of the respective pedal-supporting members in these Figs. It is noted that a stop arm 303 would not normally be used on a conventional brake pedal, since most existing brake pedal designs allow the operator to press on the brake pedal as hard as the operator wants, allowing

the driver to generate as much pressure in the master brake cylinder as the operator wants. However, it is contemplated that a stop arm 303 could (and potentially should) be used on a fully-electrically-operated brake pedal construction, where sensors (e.g. a potentiometer) detect a position of the brake pedal and where overtravel of the brake pedal would put pressure on the pedal structure instead of increasing mechanical pressure in the master brake cylinder.

In the foregoing description, those skilled in the art will readily appreciate that modifications may be made to the invention without departing from the concepts disclosed herein. Such modifications are to be considered as included in the following claims, unless these claims by their language expressly state otherwise.

The invention claimed includes:

1. An adjustable pedal apparatus comprising:

a support configured for attachment to a vehicle; and

a pedal-supporting subassembly with an upper portion pivotally engaging the support, a lower portion supporting a pedal construction, and an adjustment mechanism connecting the upper and lower portions, the adjustment mechanism including a longitudinally elongated track having a transverse cross section with an elongated vertical dimension defined by upper and lower flanges that stiffen the track, and including a follower slidably engaging the track.

2. The pedal apparatus defined in claim 1, including an actuator coupled to the pedal-supporting subassembly and adapted for operative connection to a control system of a vehicle for operating the control system when the pedal-supporting subassembly is moved.

3. The pedal apparatus defined in claim 1, wherein the adjustment mechanism includes an adjuster for adjusting the lower portion including a rack oriented parallel the track and attached to one of the track and the upper portion, and further including a driven gear operably supported on the other of the track and the pedal construction for operably engaging the rack to adjust the pedal construction along the track.

4. The pedal apparatus defined in claim 3, including a motor operably connected to the adjuster for rotating the driven gear.

5. The adjustable pedal apparatus defined in claim 1, wherein the follower is hat-shaped, and includes edges shaped to slidably engage the upper and lower flanges.

6. The adjustable pedal apparatus defined in claim 5, wherein the rack is attached to the follower.

7. The adjustable pedal apparatus defined in claim 2, wherein the pedal includes a brake pedal and wherein the actuator includes a push rod actuator adapted for coupling to a vehicle brake system.

8. The adjustable pedal apparatus defined in claim 2, wherein the pedal construction includes an accelerator pedal and wherein an actuator includes a linkage adapted for coupling to an engine control system.

9. The adjustable pedal apparatus defined in claim 1, wherein first-mentioned pedal-supporting subassembly includes a brake pedal, and further including:

an accelerator pedal-supporting subassembly pivotally engaging the support, the accelerator pedal-supporting subassembly including an upper portion with a second track having a transverse cross section with a second elongated vertical dimension defined by upper and lower second flanges that stiffen the second track.

10. The pedal apparatus defined in claim 9, including a first actuator operably coupled to the first-mentioned pedal-supporting subassembly and a second actuator coupled to the accelerator pedal-supporting subassembly and adapted for operative connection to a second control system of a vehicle for operating the second control system when the accelerator pedal-supporting subassembly is moved.

11. The pedal apparatus defined in claim 10, wherein the first-mentioned adjustment mechanism includes a first adjustor with a first rack and first drive gear for driving the follower along the first-mentioned track, and including a second adjuster for adjusting the accelerator pedal construction including a second rack oriented parallel the second track and attached to one of the second track and the accelerator pedal construction, and further including a second driven gear operably supported on the other of the second track and the accelerator pedal construction for operably engaging the second rack to adjust the accelerator pedal construction along the second track, and including a motor operably connected to the first and second driven gears for rotating the first and second driven gears simultaneously.

12. The pedal apparatus defined in claim 1, wherein the track defines top and bottom slots and wherein the follower includes opposing edges that slidably engage the slots.

13. The pedal apparatus defined in claim 12, wherein the opposing edges include bearing material attached to the edges and slides within the slots, the bearing material chosen and configured to provide a constant level of friction.

14. An adjustable pedal apparatus comprising:

a first support structure adapted for fixed attachment to a vehicle;

a pedal-supporting subassembly supported by the first support structure, the pedal-supporting subassembly including an upper portion, a lower portion supporting a pedal construction, an adjustment mechanism adjustably connecting the upper and lower portions, and a pivot on one of the first support structure, the upper portion, the lower portion, and the adjustment mechanism for pivoting the pedal construction along a predetermined path of movement relative to the first support structure when the pedal construction is depressed, the pedal construction including a connector adapted for attachment to an actuator for a vehicle system, such as a push rod actuator for a master cylinder of a vehicle braking system;

the adjustment mechanism including a longitudinally elongated track and further including a mating follower slidably engaging the track and still further including a drive mechanism for selectively motivating the follower along the track, the track having a vertically elongated cross section and the follower having a mating cross section with longitudinally extended interfacing surfaces constructed to provide a constant coefficient of friction that generates resistance when the pedal construction is depressed, the bearing material reducing excessive wear and also reducing transmission of forces directly from the pedal construction through the adjustment mechanism to the drive mechanism when the pedal construction is depressed.

15. The pedal apparatus defined in claim 14, wherein the drive mechanism includes a drive gear mounted on the track and a rack of teeth on the follower engaged by the drive gear.

16. The pedal apparatus defined in claim 15, including a reversible drive motor and cable operably connecting the drive motor to the drive gear.

17. The pedal apparatus defined in claim 16, wherein the track includes stiffening flanges.

18. The pedal apparatus defined in claim 15, wherein the drive gear is a worm gear.

19. The pedal apparatus defined in claim 18, wherein the drive gear provides about a 5:1 ratio of rotational movement of the worm gear to linear movement of the rack.

20. The pedal apparatus defined in claim 14, wherein the track defines top and bottom slots and wherein the follower includes opposing edges that slidably engage the slots.

21. The pedal apparatus defined in claim 20, wherein the opposing edges include bearing material attached to the edges and that slide within the slots.

22. The pedal apparatus defined in claim 21, wherein the bearing material is selected and configured to provide a constant level of friction.

23. An adjustable pedal apparatus comprising:

a support configured for attachment to a vehicle;

a pedal-supporting subassembly with an upper portion pivotally engaging the support, a lower portion supporting a pedal construction, and an adjustment mechanism connecting the upper and lower portions, the adjustment mechanism including a longitudinally elongated track attached to the upper portion, and including a follower slidably engaging the track that is attached to the lower portion, the follower including a rack of teeth extending at least partially along its length; and

a drive mechanism including a housing attached to the track and further including a drive gear operably mounted in the housing and engaging the rack of teeth for driving the follower along the track when the gear is rotated, and further including an electromechanical device for motivating the drive gear to move the follower.

24. The pedal apparatus defined in claim 23, wherein the electromechanical device includes a reversible drive motor and cable operably connecting the drive motor to the drive gear.

25. The pedal apparatus defined in claim 24, wherein the drive gear is a worm gear.

26. The pedal apparatus defined in claim 25, wherein the drive gear provides about a 5:1 ratio of rotational movement of the worm gear to linear movement of the rack.

27. The pedal apparatus defined in claim 23, wherein the track defines top and bottom slots and wherein the follower includes opposing edges that slidably engage the slots.

28. The pedal apparatus defined in claim 27, wherein the opposing edges include bearing material attached to the edges and that slide within the slots.

29. The pedal apparatus defined in claim 23, wherein the bearing material is selected and configured to provide a constant level of friction.

30. An adjustable pedal apparatus comprising:

a support configured for attachment to a vehicle;

a pedal-supporting subassembly with an upper portion pivotally engaging the support, a lower portion supporting a pedal construction, and an adjustment mechanism connecting the upper and lower portions, the adjustment mechanism including a track and a follower slidably engaging the track;

an actuator coupled to the upper portion and adapted for operative connection to a control system of a vehicle for operating the control system when the upper portion is moved; and

an adjuster for adjusting the adjustment mechanism; and

a stop on the pedal supporting subassembly adapted to engage a stop surface on the vehicle when the pedal construction is depressed a predetermined maximum amount.

31. The pedal apparatus defined in claim 30, wherein the stop includes a stop arm extending from one of the upper and lower portions of the pedal-supporting subassembly.

32. A method of adjusting pedals in a vehicle, comprising steps of:

providing a support structure and a pedal-supporting subassembly, the pedal-supporting subassembly including an upper portion pivoted to the support structure, a lower portion supporting a pedal constuction, and an adjustment mechanism adjustably connecting the upper and lower portion, the adjustment mechanism including a track with vertically elongated cross section and mating follower and further including a drive mechanism comprising a rack of teeth on the follower and a mating driven worm gear on the upper portion; and

adjusting the pedal construction by rotating the worm gear to drive the follower along the track and in turn adjustably move the pedal constuction along a predetermined path defined by the track.

33. The method defined in claim 32, including providing bearing material on the follower that engages the track, the bearing material being selected and configured to provide a constant level of friction, and including a step of depressing the pedal construction, whereby the bearing material in combination with the vertically elongated cross section of the track and mating follower reduce forces transmitted from the pedal construction into the drive mechanism.

AMENDED CLAIMS

[received by the International Bureau on 31 December 2001 (31.12.01);
original claims 1, 11, 14, 23 and 32 amended; new claims 34-36 added;
remaining claims unchanged (6 pages)]

1. An adjustable pedal apparatus comprising:

A support configured for attachment to a vehicle; and

a pedal-supporting subassembly with an upper portion pivotally engaging the support, a lower portion supporting a pedal construction, and an adjustment mechanism connecting the upper and lower portions, the adjustment mechanism including a longitudinally elongated track having a transverse cross section with a narrow horizontal dimension and an elongated vertical dimension defined by upper and lower flanges that stiffen the track, and including a follower slidably engaging the track.

2. The pedal apparatus defined in claim 1, including an actuator coupled to the pedal-supporting subassembly and adapted for operative connection to a control system of a vehicle for operating the control system when the pedal-supporting subassembly is moved.

3. The pedal apparatus defined in claim 1, wherein the adjustment mechanism includes an adjuster for adjusting the lower portion including a rack oriented parallel the track and attached to one of the track and the upper portion, and further including a driven gear operably supported on the other of the track and the pedal construction for operably engaging the rack to adjust the pedal construction along the track.

4. The pedal apparatus defined in claim 3, including a motor operably connected to the adjuster for rotating the driven gear.

5. The adjustable pedal apparatus defined in claim 1, wherein the follower is hat-shaped, and includes edges shaped to slidably engage the upper and lower flanges.

6. The adjustable pedal apparatus defined in claim 5, wherein the rack is attached to the follower.

7. The adjustable pedal apparatus defined in claim 2, wherein the pedal includes a brake pedal and wherein the actuator includes a push rod actuator adapted for coupling to a vehicle brake system.

8. The adjustable pedal apparatus defined in claim 2, wherein the pedal construction includes an accelerator pedal and wherein an actuator includes a linkage adapted for coupling to an engine control system.

9. The adjustable pedal apparatus defined in claim 1, wherein first-mentioned pedal-supporting subassembly includes a brake pedal, and further including:

an accelerator pedal-supporting subassembly pivotally engaging the support, the accelerator pedal-supporting subassembly including an upper portion with a second track having a transverse cross section with a second elongated vertical dimension defined by upper and lower second flanges that stiffen the second track.

10. The pedal apparatus defined in claim 9, including a first actuator operably coupled to the first-mentioned pedal-supporting subassembly and a second actuator coupled to the accelerator pedal-supporting subassembly and adapted for operative connection to a second control system of a vehicle for operating the second control system when the accelerator pedal-supporting subassembly is moved.

11. The pedal apparatus defined in claim 10, wherein the first-mentioned adjustment mechanism includes a first adjuster with a first rack and first driven gear for driving the follower along the first-mentioned track, and including a second adjuster for adjusting the accelerator pedal construction including a second rack oriented parallel the second track and attached to one of the second track and the accelerator pedal construction, and further including a second driven gear operably supported on the other of the second track and the accelerator pedal construction for operably engaging the second rack to adjust the accelerator pedal construction along the second track, and including a motor operably connected to the first and second driven gears for rotating the first and second driven gears simultaneously.

12. The pedal apparatus defined in claim 1, wherein the track defines top and bottom slots and wherein the follower includes opposing edges that slidably engage the slots.

13. The pedal apparatus defined in claim 12, wherein the opposing edges include bearing material attached to the edges and slides within the slots, the bearing material chosen and configured to provide a constant level of friction.

14. An adjustable pedal apparatus comprising:

a first support structure adapted for fixed attachment to a vehicle;

a pedal-supporting subassembly supported by the first support structure, the pedal-supporting subassembly including an upper portion, a lower portion supporting a pedal construction, an adjustment mechanism adjustably connecting the upper and lower portions, and a pivot on one of the first support structure, the upper portion, the lower portion, and the adjustment mechanism for pivoting the pedal construction along a predetermined path of movement relative to the first support structure when the pedal construction is depressed, the pedal construction including a connector adapted for attachment to an actuator for a vehicle system, such as a push rod actuator for a master cylinder of a vehicle braking system;

the adjustment mechanism including a longitudinally elongated track and further including a mating follower slidably engaging the track and still further including a drive mechanism for selectively motivating the follower along the track, the track having a narrow horizontal dimension and a vertically elongated cross section and the follower having a mating cross section with longitudinally extended interfacing surfaces constructed to provide a constant coefficient of friction that generates resistance when the pedal construction is depressed, the bearing material reducing excessive wear and also reducing transmission of forces directly from the pedal construction through the adjustment mechanism to the drive mechanism when the pedal construction is depressed.

15. The pedal apparatus defined in claim 14, wherein the drive mechanism includes a drive gear mounted on the track and a rack of teeth on the follower engaged by the drive gear.

16. The pedal apparatus defined in claim 15, including a reversible drive motor and cable operably connecting the drive motor to the drive gear.

17. The pedal apparatus defined in claim 16, wherein the track includes stiffening flanges.

18. The pedal apparatus defined in claim 15, wherein the drive gear is a worm gear.

19. The pedal apparatus defined in claim 18, wherein the drive gear provides about a 5:1 ratio of rotational movement of the worm gear to linear movement of the rack.

20. The pedal apparatus defined in claim 14, wherein the track defines top and bottom slots and wherein the follower includes opposing edges that slidably engage the slots.

21. The pedal apparatus defined in claim 20, wherein the opposing edges include bearing material attached to the edges and that slide within the slots.

22. The pedal apparatus defined in claim 21, wherein the bearing material is selected and configured to provide a constant level of friction.

23. An adjustable pedal apparatus comprising:

a support configured for attachment to a vehicle;

a pedal-supporting subassembly with an upper portion pivotally engaging the support, a lower portion supporting a pedal construction, and an adjustment mechanism connecting the upper and lower portions, the adjustment mechanism including a longitudinally elongated track attached to the upper portion, and including a follower slidably engaging the track that is attached to the lower portion, the follower including a rack of teeth extending at least partially along its length; and

a drive mechanism for the adjustment mechanism including a housing attached to the track and further including a drive gear operably mounted in the housing and engaging the rack of teeth for driving the follower along the track when the gear is rotated, and further including an electromechanical device for motivating the drive gear to move the follower.

24. The pedal apparatus defined in claim 23, wherein the electromechanical device includes a reversible drive motor and cable operably connecting the drive motor to the drive gear.

25. The pedal apparatus defined in claim 24, wherein the drive gear is a worm gear.

26. The pedal apparatus defined in claim 25, wherein the drive gear provides about a 5:1 ratio of rotational movement of the worm gear to linear movement of the rack.

27. The pedal apparatus defined in claim 23, wherein the track defines top and bottom slots and wherein the follower includes opposing edges that slidably engage the slots.

28. The pedal apparatus defined in claim 27, wherein the opposing edges include bearing material attached to the edges and that slide within the slots.

29. The pedal apparatus defined in claim 23, wherein the bearing material is selected and configured to provide a constant level of friction.

30. An adjustable pedal apparatus comprising:

a support configured for attachment to a vehicle;

a pedal-supporting subassembly with an upper portion pivotally engaging the support, a lower portion supporting a pedal construction, and an adjustment mechanism connecting the upper and lower portions, the adjustment mechanism including a track and a follower slidably engaging the track;

an actuator coupled to the upper portion and adapted for operative connection to a control system of a vehicle for operating the control system when the upper portion is moved; and

an adjuster for adjusting the adjustment mechanism; and

a stop on the pedal supporting subassembly adapted to engage a stop surface on the vehicle when the pedal construction is depressed a predetermined maximum amount.

31. The pedal apparatus defined in claim 30, wherein the stop includes a stop arm extending from one of the upper and lower portions of the pedal-supporting subassembly.

32. A method of adjusting pedals in a vehicle, comprising steps of:

providing a support structure and a pedal-supporting subassembly, the pedal-supporting subassembly including an upper portion pivoted to the support structure, a lower portion supporting a pedal construction, and an adjustment mechanism adjustably connecting the upper and lower portion, the adjustment mechanism including a track with a narrow horizontal dimension and a vertically elongated cross section and mating follower and further including a drive mechanism comprising a rack of teeth on the follower and a mating driven worm gear on the upper portion; and

adjusting the pedal construction by rotating the worm gear to drive the follower along the track and in turn adjustably move the pedal construction along a predetermined path defined by the track.

33. The method defined in claim 32, including providing bearing material on the follower that engages the track, the bearing material being selected and configured to provide a constant level of friction, and including a step of depressing the pedal construction, whereby the bearing material in combination with the vertically elongated cross section of the track and mating follower reduce forces transmitted from the pedal construction into the drive mechanism.

34. The pedal apparatus in any of the preceding claims, wherein the track is C-shaped and includes an open side facing the follower.

35. The pedal apparatus in any of the preceding claims, wherein the follower includes blade-shaped edges that are each captured in and slidably engage the track.

36. The pedal apparatus in any of the preceding claims, wherein the track has a height at least three times the track's width.

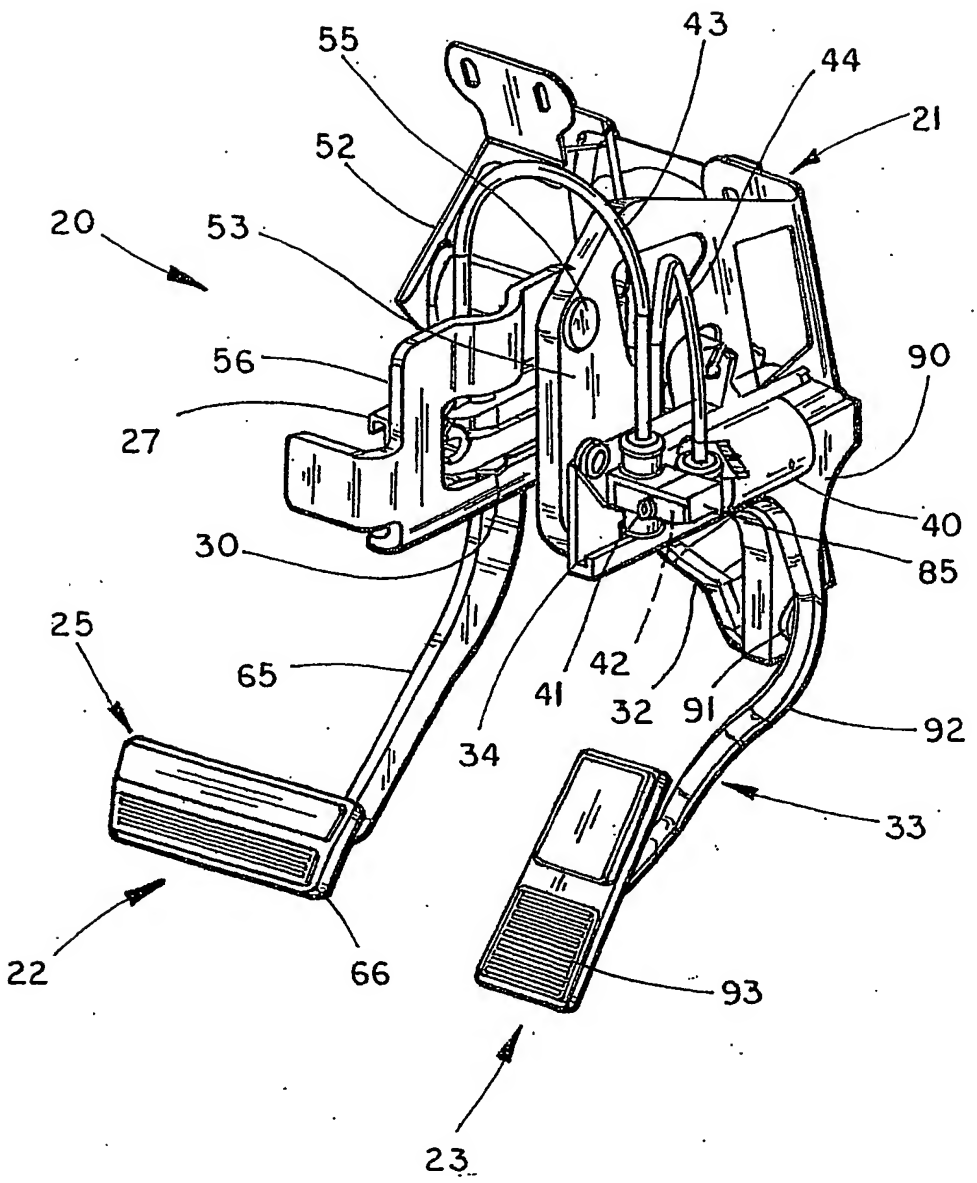
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Fig. 1

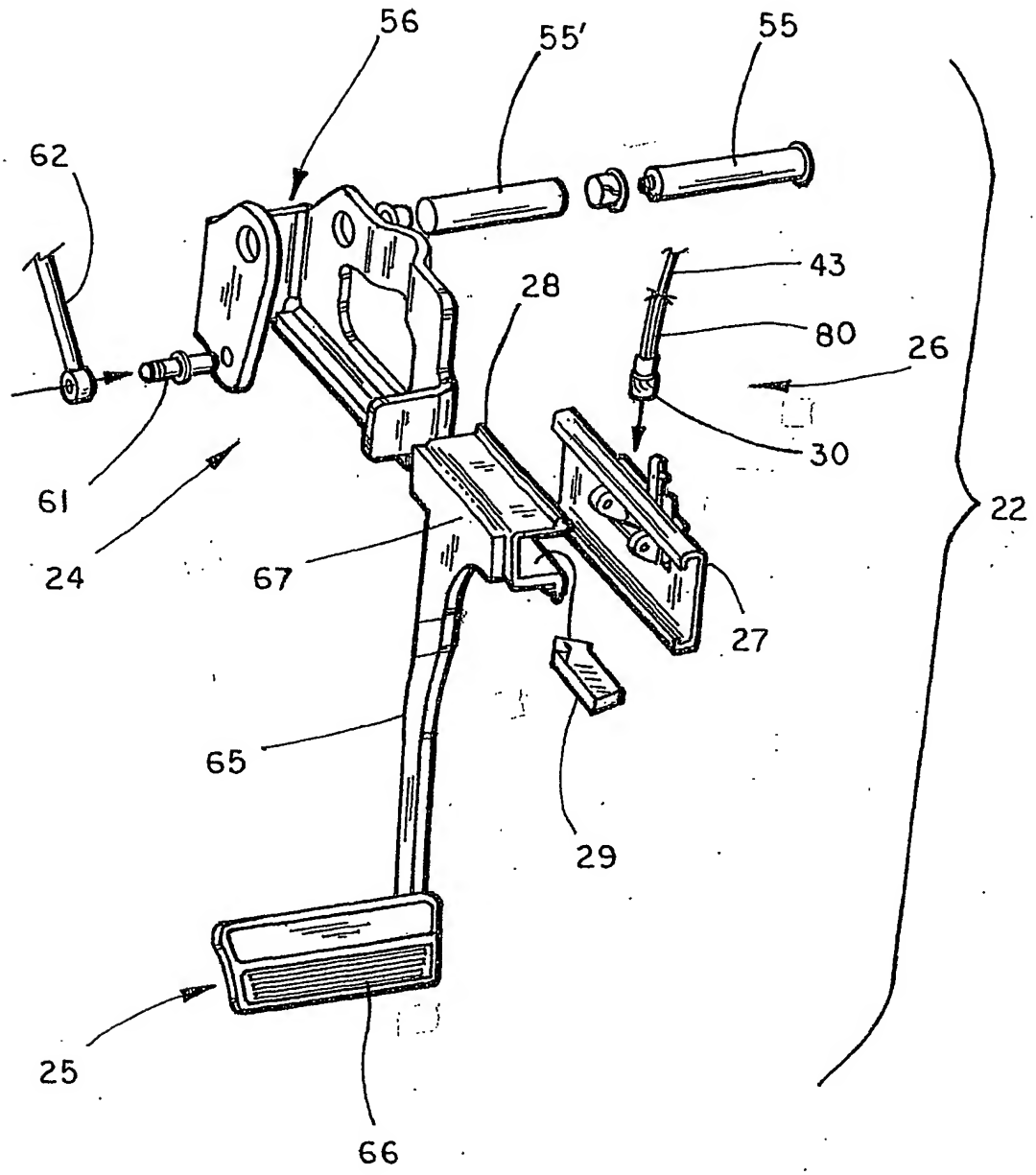


Fig. 2

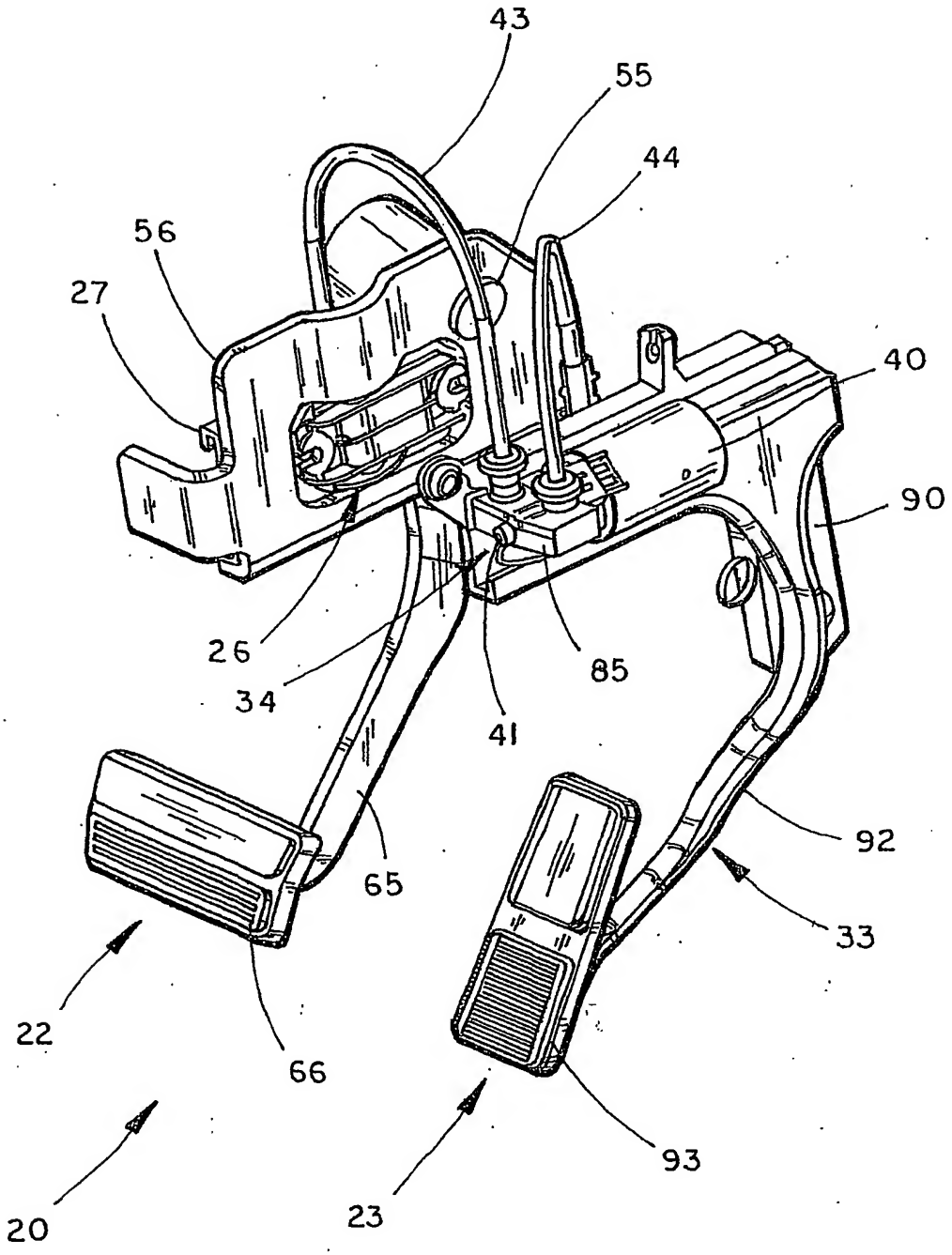


Fig. 3

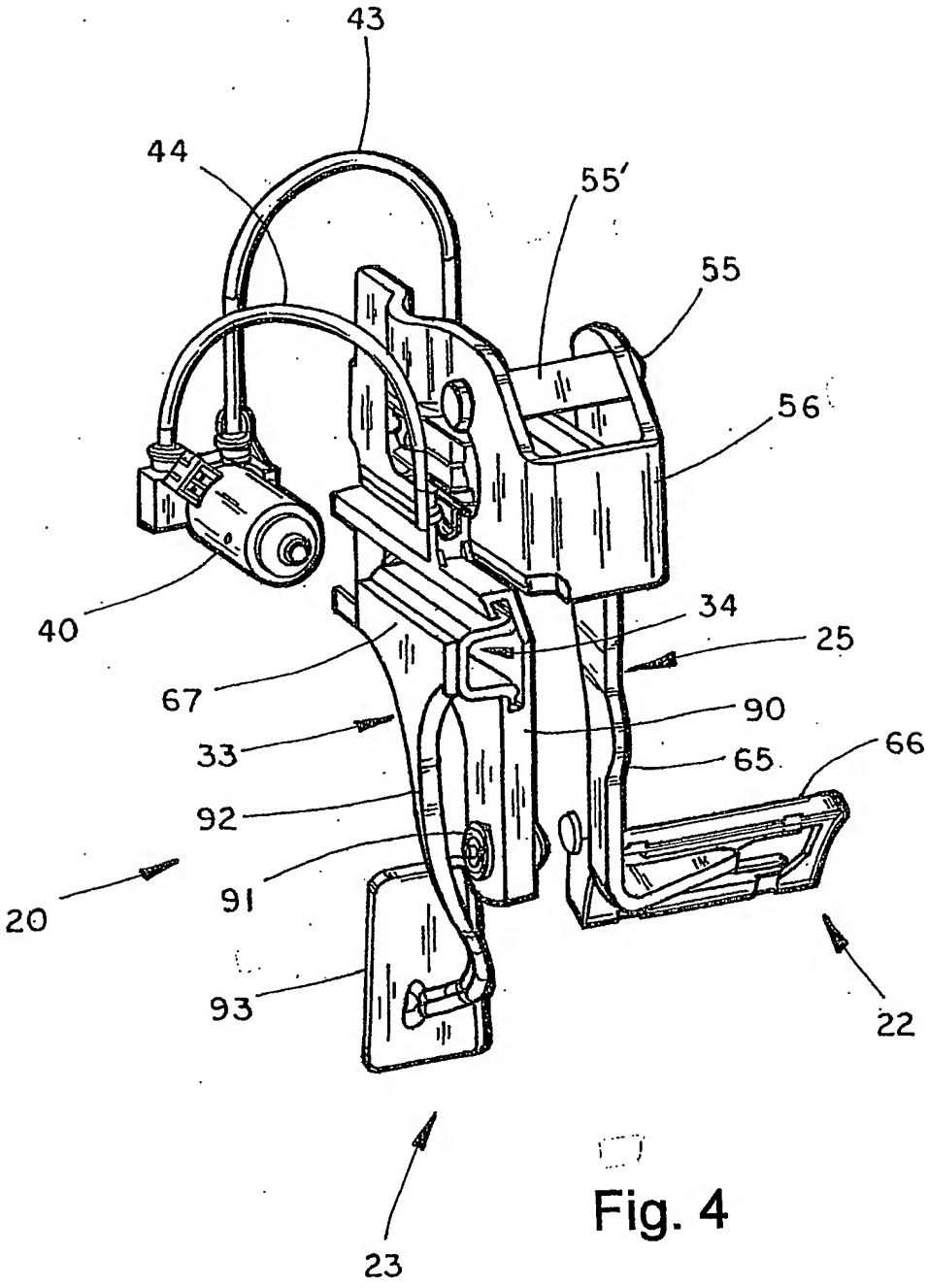
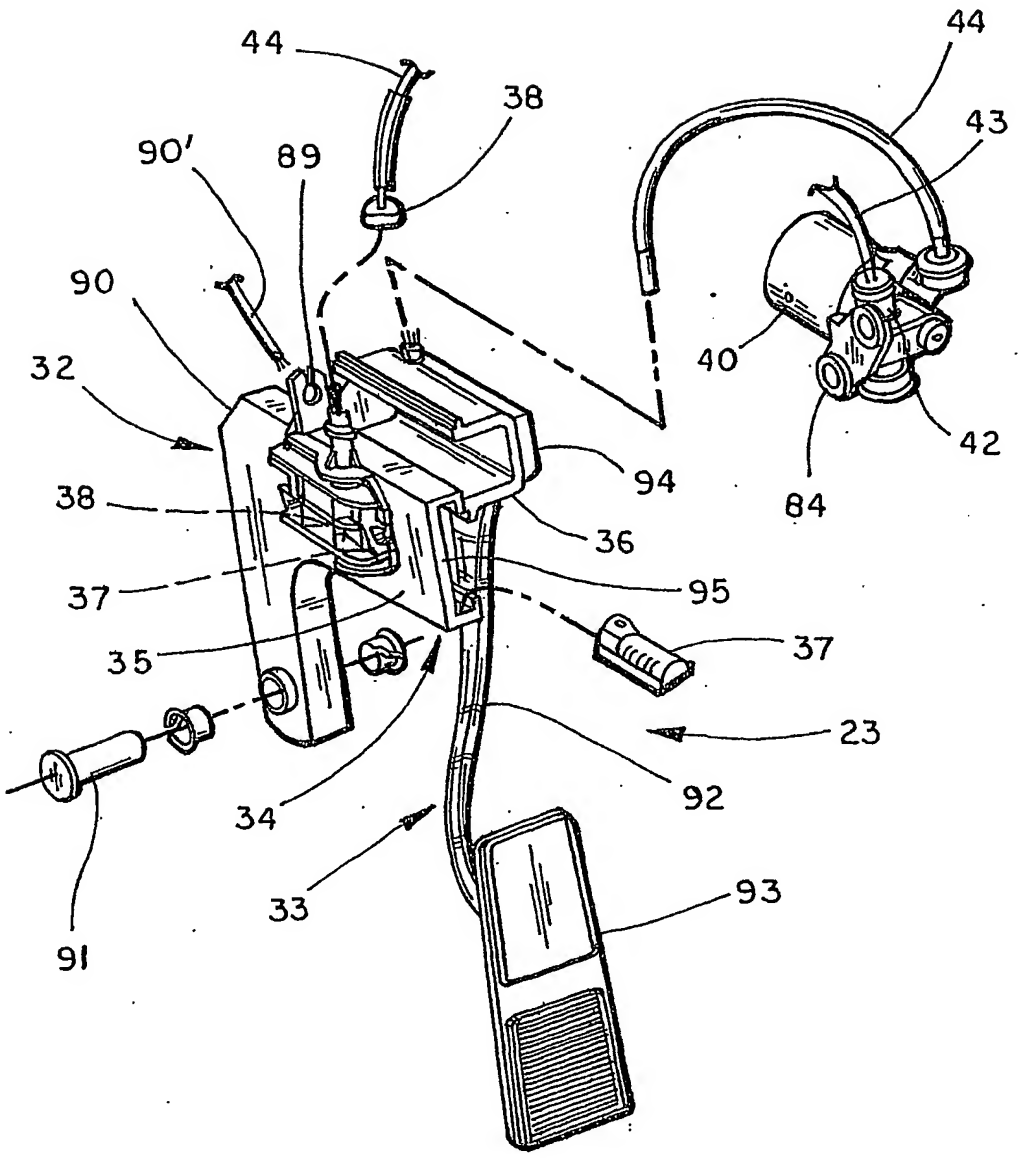


Fig. 4



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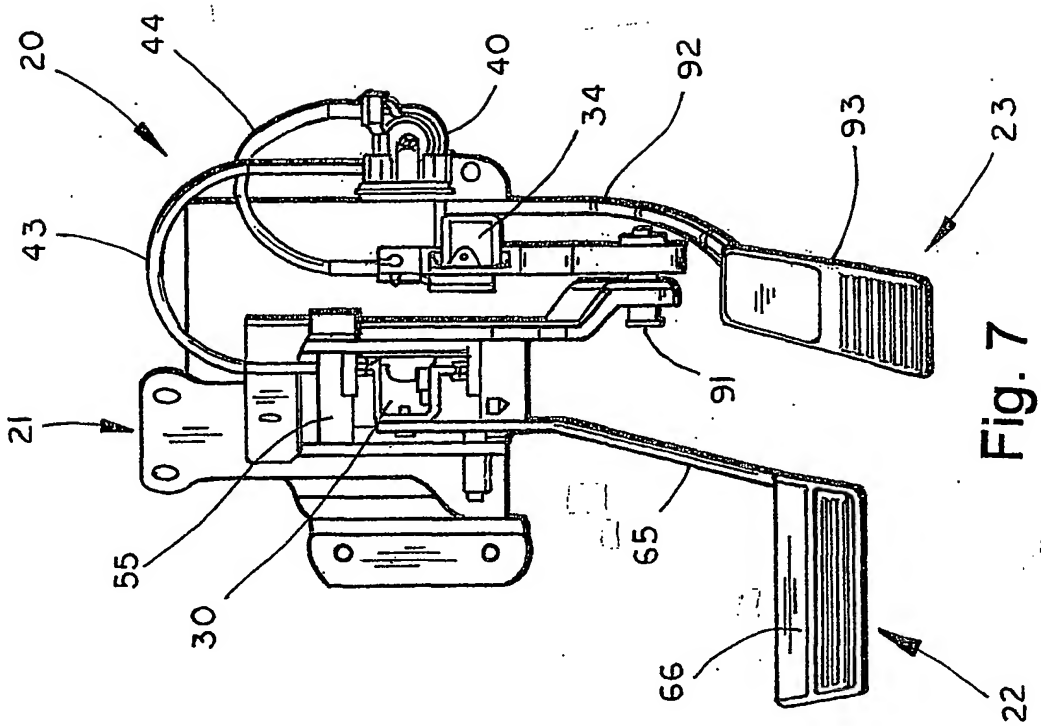
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Fig. 7

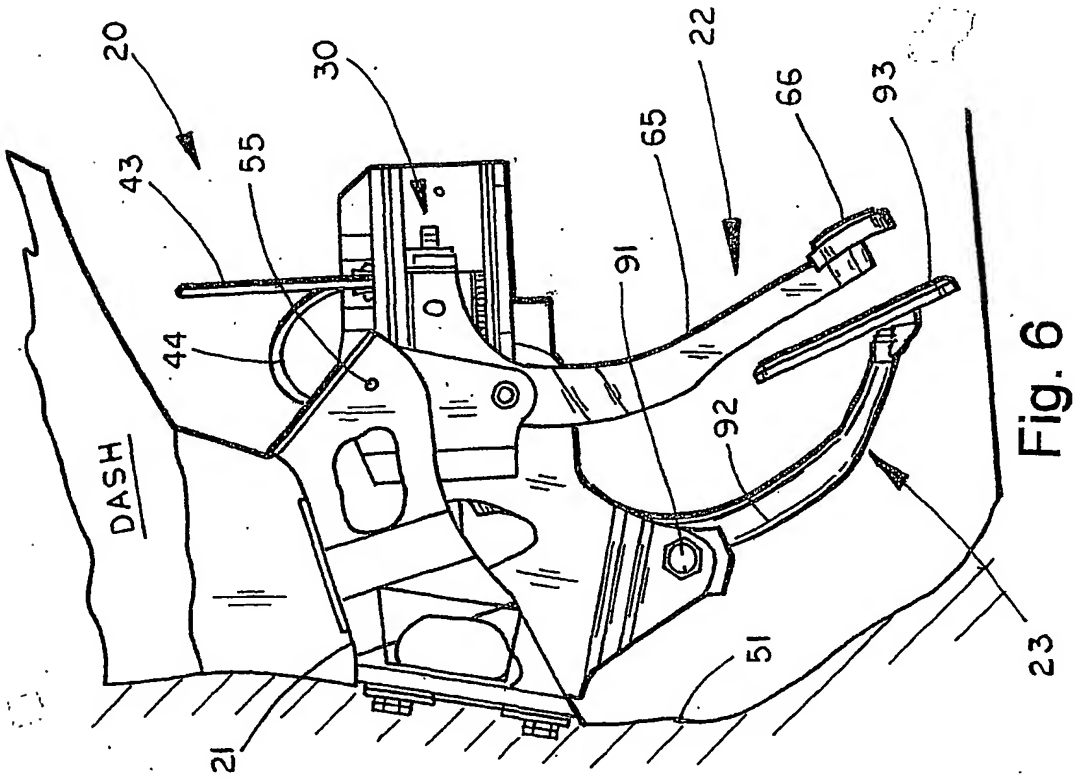
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Fig. 6

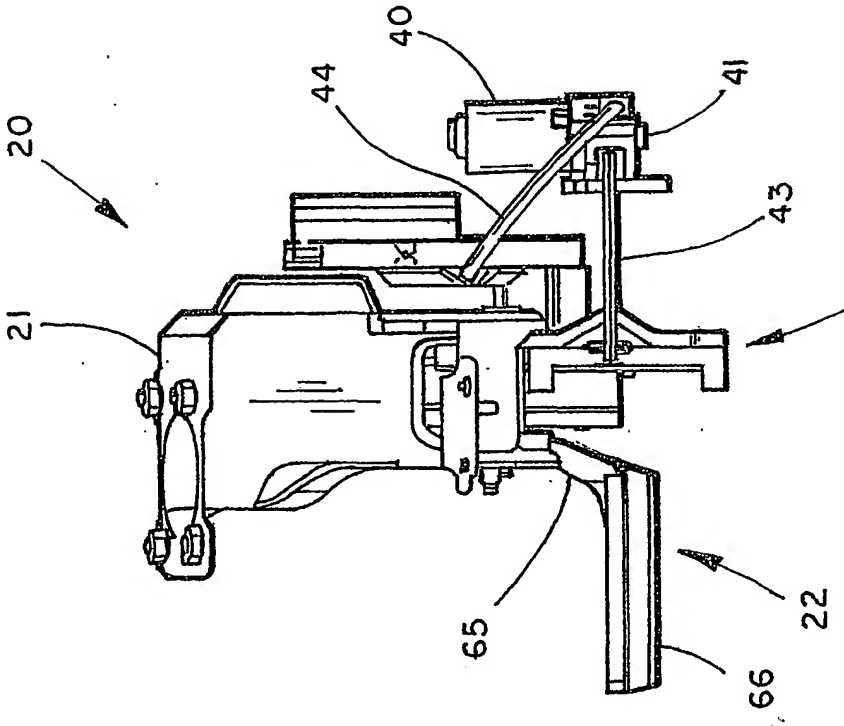

Fig. 9

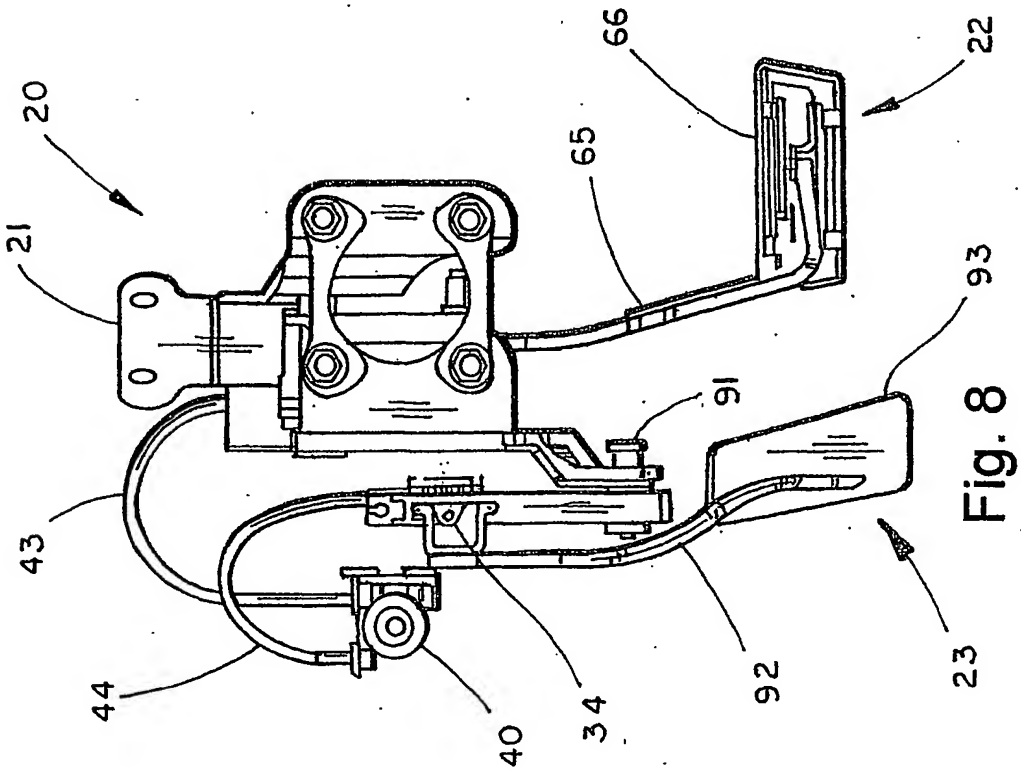

Fig. 8

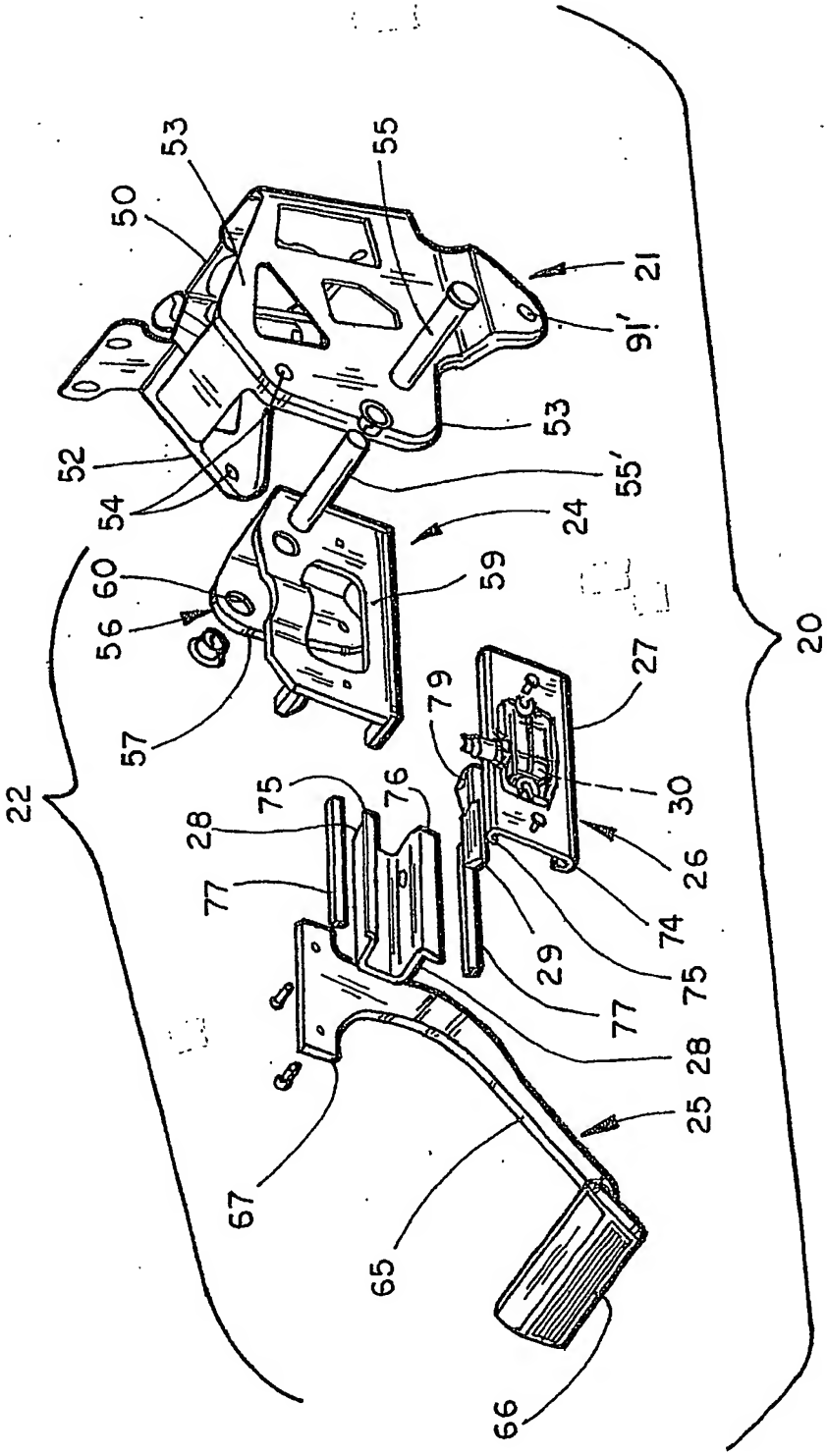
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Fig. 10

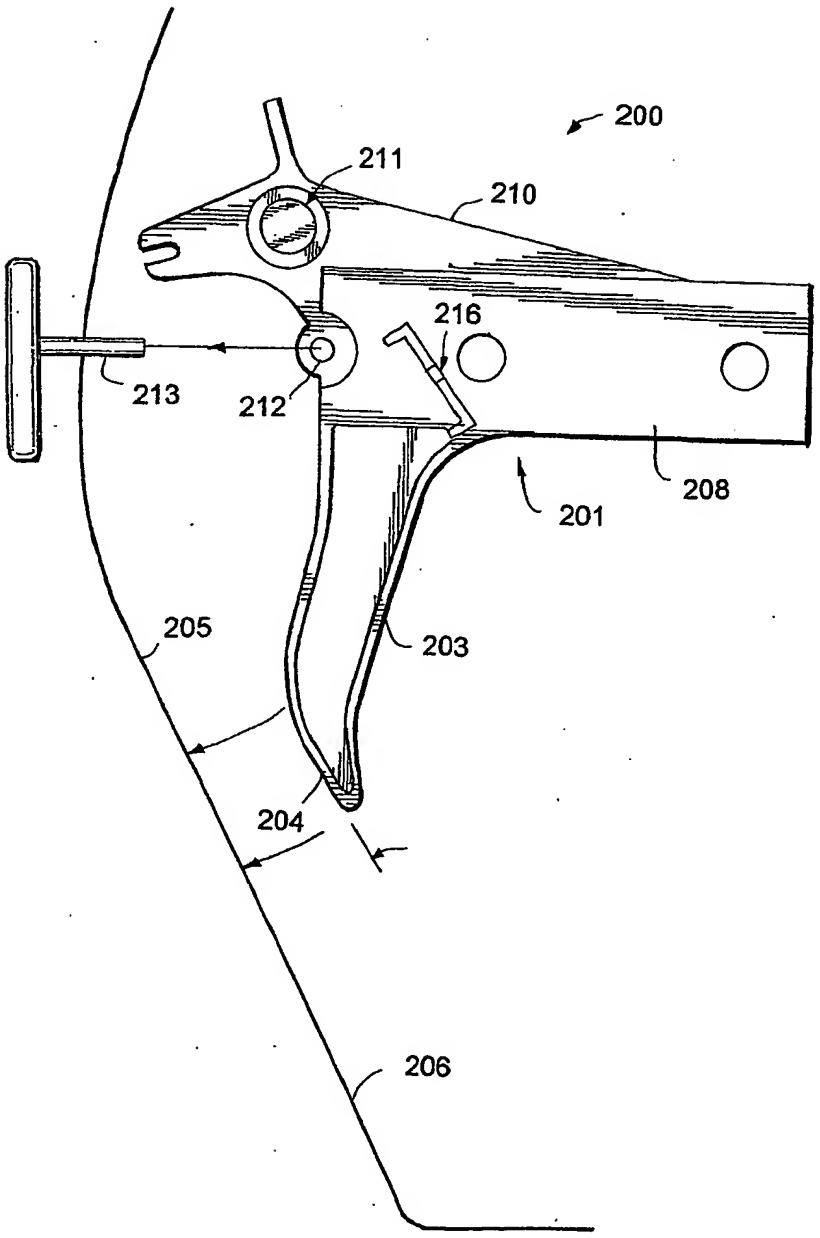

Fig. 11

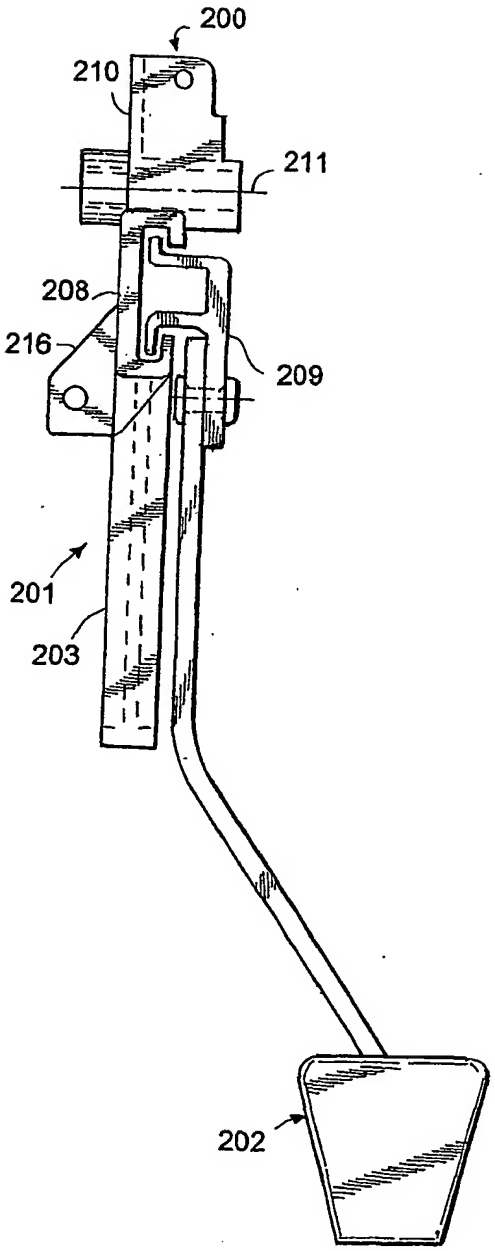

Fig. 12

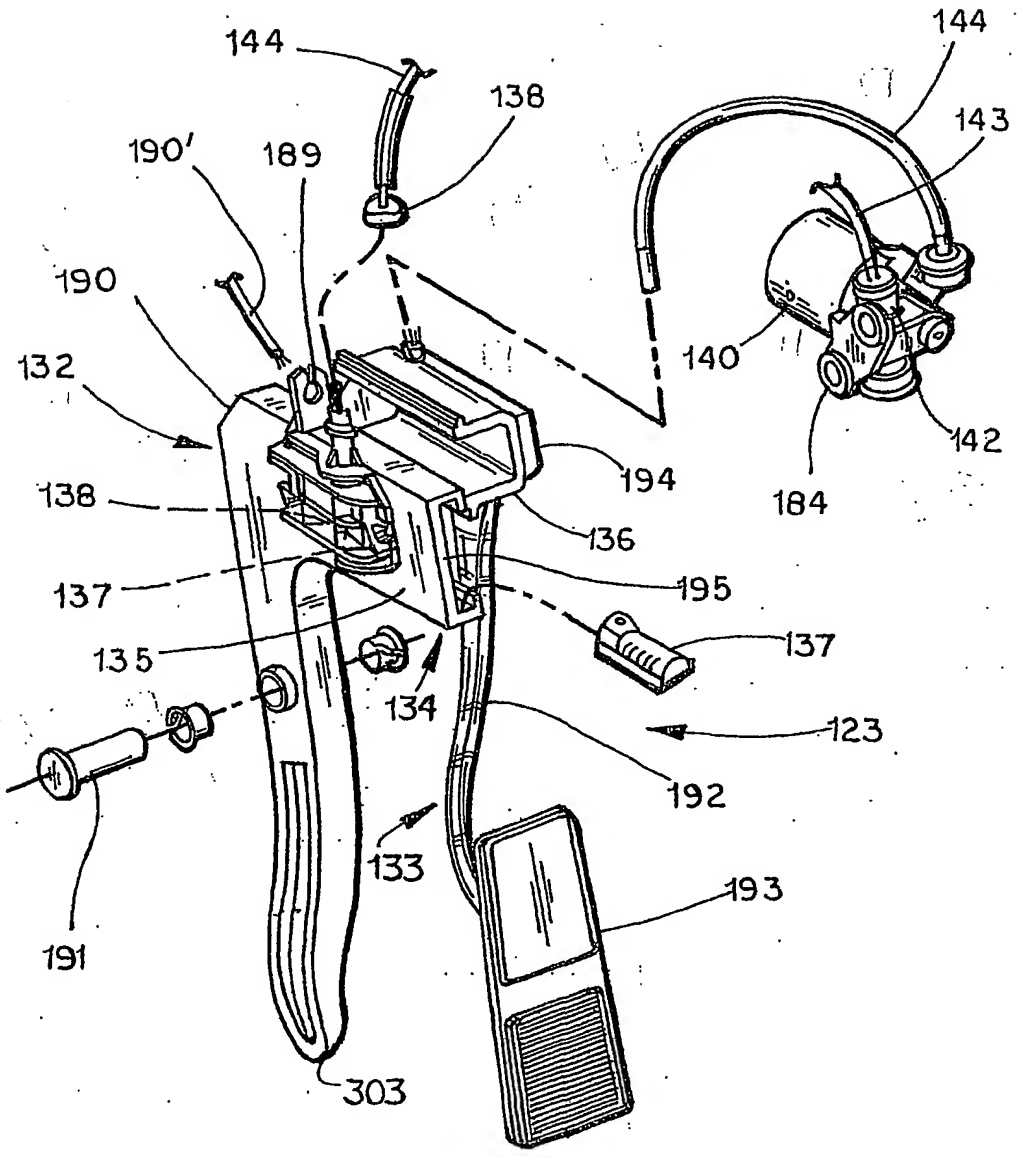
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Fig. 13

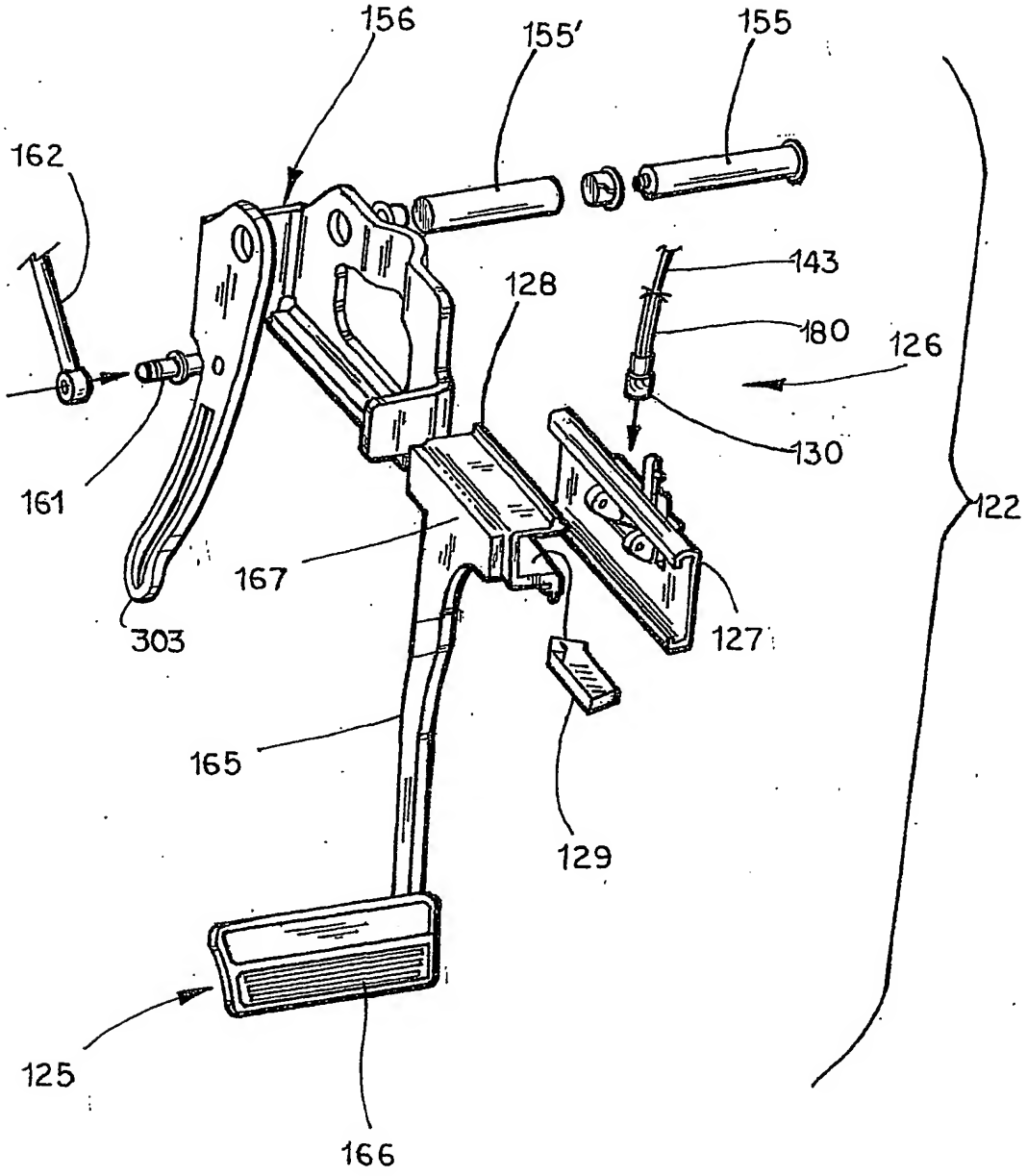
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Fig. 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/22413

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :G05G 01/14
US CL : 74/512,560

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 74/512,560

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X, E	US 6,293,584 B1 (LEVINE) 25 September 2001, entire document.	1-10, 12, 14-20, 23-27, 32 and 33
Y, P	US 6,247,381 B1 (TOELKE et al) 19 JUNE 2001, Figure 1.	11
Y	US 5,261,143 A (TOTH) 16 November 1993, col. 7, lines 56-68.	13, 2, 22, 28, 29
Y	US 4,353,430 A (SJOQVIST et al.) 12 October 1982, col. 3, lines 52-54.	30 and 31
Y, P	US 6,173,625 B1 (MCFARLANE et al) 16 January 2001, col. 3, lines 40-55.	30 and 31

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
03 OCTOBER 2001	30 OCT 2001
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer David A. Bucci Diane Smith for Telephone No. (703) 308-3668

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